

Name: _____

Analyzing Amino-Acid Sequences

Two proteins are commonly studied in attempting to deduce evolutionary relationships from differences in amino-acid sequences. One is cytochrome c, and the other is hemoglobin. Cytochrome c is a protein used in cellular respiration and found in the mitochondria of many organisms. Hemoglobin is the oxygen-carrying molecule found in red blood cells.

In this lab, you will compare portions of human cytochrome c and hemoglobin molecules with the same portions of those molecules in other vertebrates. You will determine the differences in the amino-acid sequences of the molecules and deduce the evolutionary relationships among the vertebrates.

Procedure:

1. Use the amino acid charts provided. You will be comparing the amino-acid sequence of human cytochrome c with that of each of the other seven vertebrates by counting the differences. You will use your fingers to compare and look for differences in the sequences. Record the differences in the table below:

Table 1 Cytochrome C Amino-Acid Sequence Differences

Vertebrate	Number of differences from human cytochrome c
Monkey	
Rabbit	
Horse	
Chicken	
Turtle	
Frog	
Shark	
Tuna	

2. Use the amino acid sequences provided. You will be comparing the amino-acid sequence of human hemoglobin with that of each of the other four vertebrate's hemoglobin. You will again use your fingers to compare and look for the differences in the sequences. Record the differences in the table below:

Table 2 Hemoglobin Amino-Acid Sequence Differences

Vertebrate	Number of differences from human hemoglobin
Chimpanzee	
Gorilla	
Monkey	

Analysis

1. According to the data in Table 1, which vertebrate is most closely related to humans?

2. According to the data in Table 1, which vertebrate is least closely related to humans?

3. According to the data in Table 2, which vertebrate is most closely related to humans?

4. According to the data in Table 2, which vertebrate is least closely related to humans?

5. If the amino-acid sequences in gorillas and humans are similar, are the nucleotide sequences of their DNA also similar? EXPLAIN YOUR ANSWER

6. According to the data listed in Table 2, what conclusion can you make about how closely the three primates - chimpanzee, gorilla, and monkey - are related to each other and to humans? Be sure to discuss ALL THREE.

7. Use Table 1 to compare the amino acid sequences for cytochrome c from sharks, turtles and monkeys. Which of these is more closely related? WHY do you think so?

8. In what way do proteins behave like molecular clocks?

A. The greater the number of changes, the more time has passed.

B. The fewer the number of changes, the more time has passed.

SUMMARIZE THIS ACTIVITY BY EXPLAINING HOW DNA COMPARISON CAN BE USED TO DETERMINE RELATEDNESS OF ORGANISMS.
